VOL. XIX] [No. 3.

THE

INDIAN FORESTER;

A MONTHLY MAGAZINE

OF

FORESTRY,

AGRICULTURE, SHIKAR & TRAVEL

EDITED BY

J. S. GAMBLE, M.A., F. L. S.,

CONSERVATOR OF FORESTS, AND DIRECTOR OF THE FOREST SCHOOL, DEHRA DÚN.

MARCH 1893

MUSSOORIE:

PRINTED BY THE MAFASILITE PRINTING WORKS COMPANY, "LIMITED."

1893.

143

Contents.

No. 3—March, 1893.

Page.

I.—Original Articles and Translations.

On Forest Settlement and Administration, by 'Futaie' 91
Injury by insects and value to Forests of the enemies of those Insects:—Translated from the Forst und Jagd Zeitung by S. E.-W. Part I. ... 96
Beetles which girdle Rose bushes 102
The Forests of the United States of North America, by O. C. 103

II.—Correspondence.

Are the rings of Avicennia wood annual? Letter from A. W. Lushington, ... 104

III.—Official Papers and Intelligence.

Rights of Way. 105

IV.—Reviews.

The Forage plants of Australia 106
Forestry in S. Australia in 1891-92. 108
Annual Report on Agriculture in Bombay, 1891-92. ... 109
The Bengal Forest Report for 1891-92. ... 110

V.—Shikar.

A trip to Bara Bangahal, by F. O. L. No. 3 ... 113

VI.—Extracts, Notes and Queries.

The obstacles to Home timber growing ... 116
Lord Lansdowne on the Forests of India ... 117
Working of the Circular Saw ... 118
The 'Kurri' wood of W. Australia as a Paving-Material 120

VII.—Timber and Produce Trade.

Churchill and Sim's Circular, February 2nd, 1893. ... 121
Market Rates of Products 121
Statement of average selling rates in N. W. Provinces for Quarter ending December 31st 1892. ... 122

VIII.—Extracts from Oeficial Gazettes.

Appendix Series.

Resin and Turpentine from Indian Pines.

THE

INDIAN FORESTER.

Vol. XIX.] March, 1893 [No 3.

On Forest Settlement and Administration.

It appears from an article in the April 1892 number of the *Indian Forester*, by Mr. Baden-Powell, who has had good opportunities for forming a correct opinion, that the way in which the forests have been settled is, generally speaking, not entirely satisfactory. The same conclusion has, I dare say, been arrived at by others who have had much to do with settlement work. In the earlier days of the Forest Act, the chief object of the settlement officer was, so far as my experience goes,* to "reserve" as much as possible of what he considered really valuable† forest; to "protect" the whole of the remaining waste-lands after leaving a margin for the extension of cultivation; to declare the whole area free of rights; to grant concessions freely all over the protected area; and to keep the reserved area free of all concessions. This mode of procedure enabled the 'settlement' to progress rapidly, as, although some care was deemed necessary in the selection of reserved areas, but little trouble was taken in the selection of the protected areas which was often done in a very summary, hap-hazard fashion. It also fell in entirely with the view generally held that this was the only mode of selection which would enable villagers to have ample areas of the permanent forest lands from which to help themselves to produce and in which to graze their animals at will. The one advantage of the system, from the forester's point of view, was that it gave to the Forest Department certain areas over which it was intended that the latter should have full control, and over which, as a matter of fact, it was given full control. A disadvantage was that these areas of protected forest, often largely exceeding the reserved areas, were invariably situated in the most frequented and populous parts of the country, in the vicinity of towns, villages and cultivation, and were really far more in need of settlement (in the interests of the surrounding population) than the reserved areas.

*It is scarcely necessary to say that these remarks, as well as those which follow, have reference only to the somewhat limited sphere which has come under my own observation

† i.e. These areas which were stocked with the biggest and most marketable trees. Other economical matters were not thought of

APPENDIX SERIES

OF

THE INDIAN FORESTER.

RESIN AND TURPENTINE

FROM

INDIAN PINES.

In this hand-book the available information as to the extent of pine forests available and manufacture of turpentine on the North-Western Himálaya and in Assam and Burma has been brought together in amplification of a summary of the main facts elicited by enquiries as to the likelihood or possibility of establishing a trade in turpentine between India and England, which was sent to the Secretary of State in 1885.

The chief countries in which resin is obtained, and in which facilities exist for the production of colophany and turpentine, are France and America.

I.—FRANCE.

The manufacture of resinous products from the maritime pine (P. pinaster) is carried out on an enormous scale in the departments of the Gironde and Landes. The processes of collecting the resin and manufacture of the products are fully described by M. Croizette Desnoyers in his "Notice sur le gemmage du Pin maritime"* from which the following account is taken :—

1.—Collection of the Resin.

The maritime pine contains very large and abundant resiniferous canals. But, as the resinous juices are much more active in the sap-wood than in the heart-wood, light vertical incisions will expose these canals, and produce a flow of resin. On this principle the extraction of the resinous matter depends.

Towards the end of February or at the beginning of March the operation is started by removing the rough outer bark, so that only the last few layers of bark tissue are left outside the sap-wood. The bark should only be removed over that portion of the trunk which will be resined during the season. An allowance is made of 10 centimetres for the height and 2 to 3 centimetres for the width, this operation having

* Exposition Universelle, Paris, 1878. Ministère de l'agriculture et du commerce, Administration des Forêts.

the following objects: (1) to prevent the débris of the bark from falling into the receiving vessel; (2) to avoid blunting the edge of the cutting instrument and losing resinous matter by the roughness of the bark.

The second operation, which is generally performed from the 1st to the 10th of March, consists in cutting the sap-wood, and consequently the resiniferous canals, with the axe (*abchotte*). The resin tapper commences by making at the foot of the pine an incision, called the cut,* which is convex above, and has a width of 10 centimetres, a height of 3 centimetres, and a depth of 1 centimetre.

The resin oozes out in viscid and transparent droplets, which become inspissated in contact with the air. A portion, called *galipot*,† solidifies and forms a crust on the cut, and the remainder, which is more liquid, flows into a pot.

Every week, and in the season during which the pines yield abundantly every five days, the cut is refreshed by *piquage*, *i.e.* the removal of a thin shaving at its upper part, so that it continually increases in height while maintaining a constant or even decreasing length.

In making the *piquage* the resin tapper revives the wound over a length of 10 to 12 centimetres, but takes care—and in this his skill is tested—to remove at each *piquage* only an extremely thin pellicle, so that the wound may be refreshed as frequently as possible without exceeding the depth of 1 centimetre. The *piquage* takes place about 40 to 45 times in the year.

When the pot is sufficiently filled, which occurs every fifteen to twenty days, the resin tapper empties it into a wooden basket, replaces the pot, and transports the contents to big reservoirs called *barcous*, which are made of wood or bricks here and there in the forest.

There are two methods of tapping: tapping to death (*gemmage à mort*) and cautious tapping (*gemmage à vie*).

The former is applied both to pines which have to disappear in the thinnings and to those which have reached the term of exploitation or turn for regeneration. Under these conditions, as the pines have only a short time to live, as much resin as possible is extracted, and several cuts—two to six according to the size of the tree—are made simultaneously.

The latter is only practised on trees which it is desired to preserve for a long time. It is necessary, therefore, to tap them in such a way as not to exhaust them and completely arrest their vegetation. With this in view, only one cut at a time is opened. When the first cut, at the end of five years, has reached the height of 3m. 80, the tree is allowed to rest during several seasons, and, only after this period, a new incision is made, either from 15 to 20 centimetres from the abandoned cut, or on the opposite side of the pine. The operations are carried out in the same manner as in the first instance. In this way a circuit of the tree is made, and the intervals between the old notches are tapped in rotation; and, with these consecutive periods of tapping and rest, not only are the pines resined, but are also kept alive for a long time.

[As regards the methods of tapping and management of the pine in the Dunes of Gascony, Colonel Bailey‡ makes, *inter alia*, the following observations:—

Gemmage à mort is adopted in all thinnings of trees aged 25 years

* The cuts, when left alone, soon heal up by the formation of new rings of wood and bark, and some time after a new cut may be opened in the swelling formed by the bark over the old cut.

† This is scraped off once or twice a year.

‡ *Indian Forester*, February, 1883.

and upwards, and also in the seed felling, as well as in the final felling. The operation is commenced five years before the trees are to be cut down, and is continued for four years. The aim is to take all the resin that the tree can give, leaving it exhausted at the end of the fourth year. One result of this treatment is to cause an abundant growth of seed; and this fact has great importance when the last representatives of the crop are about to be removed, for it ensures the springing up of a full crop of seedlings.

Gemmage à vie.—The trees are not tapped until they have a girth of from 44 to 48 inches, which is usually attained when they are from 30 to 40 years old.

Management of the pines.—The pine has long thin needles giving very light shade, and the trees will not stand being grown close together. Those only which are sufficiently far apart, vigorous, and have a well-developed crown, yield resin in large quantities. Thinnings are commenced when the young trees are from 6 to 8 years old, and are repeated every five or six years. When the forest is 20 years of age, there should be from 250 to 280 stems per acre; but at 30 years not more than 100 to 120 of these should remain, the number being finally reduced to from 60 to 80 when, at the age of 70 or 80 years, regeneration fellings are commenced. With this number on the ground, the upper or cone-bearing branches are free, but not the lower ones. These latter should be allowed to touch, so that the natural pruning of the lowest of them may be effected. In order that the extraction of resin may be successfully carried on, it is necessary that the trees should have clean stems, free of dead branches, up to a height of some 16 feet; and to ensure this it is usual, as an additional precaution, to prune away the lower branches at the time that the first thinnings are made, that is, when the forest is not more than from 6 to 8 years old; but this has to be done carefully, avoiding the removal of too many leaves at a time, as otherwise the growth of the young trees would be checked. It is considered that the introduction of oak (Q. **pedunculata**) beneath the pine would be of great value as a protection to the soil, and as a means of keeping down the undergrowth of grass, gorse, brooms, etc., thus diminishing the risk from fires.

The resin is collected either in a hole scooped out in the sand, or in a glazed earthenware pot.* The first of these systems is very primitive, and possesses inconveniences which do not exist in the other, which is known as the *système Hugues*. The pot is placed beneath the notch from which the resin issues. Each year the resin tapper raises the pot, so that it is at the upper end of the cut worked during the preceding season. It is kept in its place by a nail beneath it, and, when a new cut is worked, the pot is placed on the ground at the foot of the tree.]

2.—Manufacture of Resinous Products.

The resin, as it is placed in the boiler, is made up of a mixture of an essential oil, turpentine, and foreign substances, solid or liquid, resulting from

* To diminish waste, the pot may be covered with a board, which prevents loss of the volatile part of the resin. To get the resin to flow into the pots, a small curved plate of zinc is lightly driven in an oblique direction into the wood immediately over each pot; or a flat plate of zinc with one corner slightly curved upwards is driven in obliquely across the cut, the curved corner being immediately over the pot, which is hung on one side of the cut. When there are irregularities in the stem, or when it does not stand perpendicularly, chips of wood, driven into the wood and ingeniously arranged, guide the resin in the required direction.

prolonged stay in the pots or reservoirs in the forest. Like all essential oils, turpentine is a mixture of an essence called essence of turpentine and a resin called colophany.

Essence of turpentine has a density of 0·85. It is a colourless, sticky liquid, with a characteristic odour, boiling at 157°, and volatilising easily in contact with hot water and steam at 100°. The density of the vapour of the essence is 4·7.

Colophany is a solid amorphous body, of a more or less deep honey-yellow colour, which has a density of 1·08, softens at 70°, melts at 135°, and boils at 200°.

The double principle on which the extraction of the turpentine or its derivatives rests is that :—

1. By liquefaction and filtration of the resin, the turpentine is separated from the water, gas, earth, and wood which are accidentally mixed with it.
2. By distillation of the turpentine, which is an intimate mixture of a solid and liquid with very different boiling points, the essence of turpentine and colophany can be separately collected.

The resin is placed in a boiler, closed by a movable lid, which is heated at the same time by an open fire and by steam circulating in the pipes A, A′, A″, A‴ [Fig. 1]. After five or six hours the temperature reaches 90°C and the

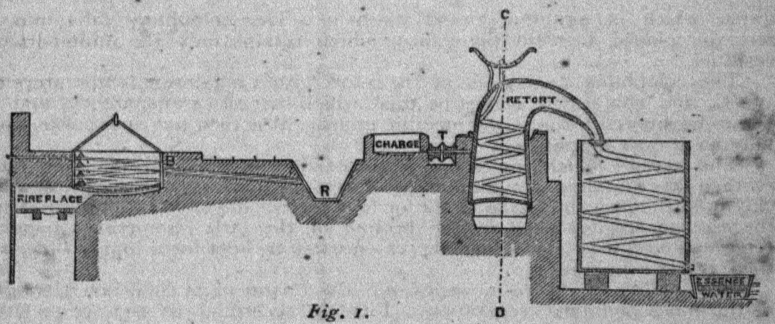

Fig. 1.

liquefaction is complete. At B there is an aperture provided with a grating, and everything which is above this kind of filter flows into the receptacle R. There only remains in the boiler a small quantity of turpentine mixed with foreign substances.

The turpentine is next transported from the receptacle R into a reservoir called the *charge* which measures exactly the quantity which should be introduced, at each operation, by the pipe T into the still.

Pipes pierced by small holes permit the introduction of steam into the retort when the turpentine is at a temperature of 135°C. Effervescence is then produced, and the essence is completely set free. The average charge of the retort is about 300 litres.

At E (Fig. 2) there is an aperture closed by a wooden stopper, which is carefully cemented. When the essence no longer passes into the worm,

the operation is stopped. The colophany flows through the pipe E into a receptacle, and is put into a half cylinder made of very fine metal

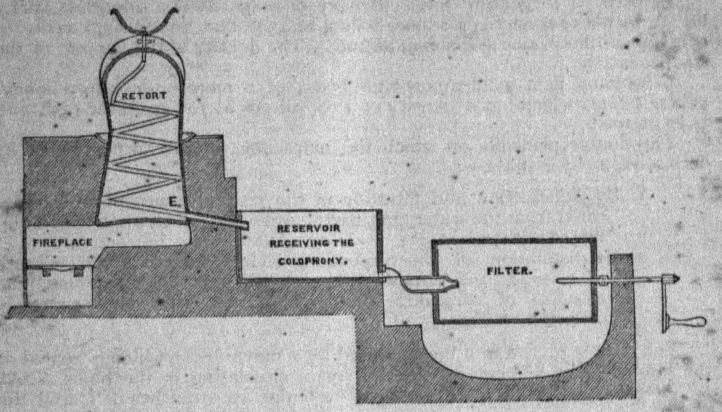

Fig. 2.

gauze which is agitated round its axis. The colophany falls into a reservoir placed beneath the gauze, which retains only the unimportant residue.

The colophany comes out of the retort with a maximum temperature of 130°C, and contains a very fine dust, which mars its transparency, and it has to be filtered through the metallic gauze. It is then put into casks, and may be at once despatched.

The essence which comes out of the condenser, being turbid, is put into earthen jars containing each about 300 litres. The covers are cemented with clay, and the jars allowed to stand for four or five days. The impurities in the essence are deposited at the bottom of the jars. Sometimes copper reservoirs are used, in which the essence can be kept for a longer time, as there is less evaporation.

The quality of the resin varies with the season of its collection, the age of the pines and their vegetation. Further, according as the season advances, the resin is less rich in essence, and, consequently, increases in weight, distillation is more difficult, and greater heat must be applied.

[The process of manufacture of resin, as carried out in a factory which he visited when travelling from Bordeaux to Arcachon is thus described by Colonel Bailey :*—The crude resin, brought to the factory in casks, is, notwithstanding the precautions taken, found to be mixed with a certain quantity of foreign substances, such as earth, chips, bark, leaves, insects, etc. After adding about 20 per cent. of solidified resin (*barras*) scraped from the cuts, it is heated moderately in an open caldron so as to bring it into a liquid state, when the heavier impurities sink to the bottom, and the lighter ones rise to the surface. The liquefied resin, thus obtained, consists of two distinct substances, *viz.* colophany, which is solid at the ordinary temperature of the air, and spirit of turpentine, which is liquid and volatile, and some of which is lost if the caldron is over-heated. These two sub-

* *Loc. cit.*

stances are separated by distillation in the following manner:—The liquid resin is allowed to run through a strainer into a retort, a small quantity of water being introduced at the same time. The rising steam carries the spirit of turpentine with it, and both are, after passing through a refrigerator, caught in a liquid form, in a trough placed to receive them. The spirit, being lighter than the water, lies over it and is easily drawn off. The colophany is then allowed to run out of the retort, and, passing through a sieve, is caught in a vat below. Thence it is poured into flat metal dishes and allowed to harden in the sun, under which process the finer qualities acquire a delicate amber colour. The impure resin left in the caldron is distilled separately, and yields resin and pitch. The spirit of turpentine sells for 24*s.* per 100lb, and the colophany for 9*s.* per 100lb, but the purer kinds, for the manufacture of which only the most liquid portions of the raw resin are put into the caldron, fetch from 13*s.* 6*d.* to 14*s.* 6*d.*, the price of the finest quality, known as Venice turpentine, rising to £4-10*s.* per 100lb.]

3.—Uses of the Resinous Products.

Essence of turpentine enters into the manufacture of oil paints, varnishes, different kinds of coating and caoutchouc.

Colophany and dry crude resin are used for sizing paper, for obtaining the oils with which vegetable fats and printing ink are made, and for coating the interior of beer barrels. They also enter into the composition of some varnishes and sealing waxes, and are used for bending leaden pipes. Acid colophanies form, with caustic alkalis or alkaline carbonates, salts which possess properties analogous to soaps. These resinous soaps behave exactly like those which proceed from fatty bodies; and, as they absorb atmospheric moisture very readily, they are generally mixed, in varying proportions, with ordinary soaps. The resin, by replacing a portion of the fatty acids, appreciably diminishes the cost.

Galipot enters into the composition of varnishes, and is employed in the dockyards for painting the masts and sides of ships.

The refuse of manufacture of the various products can be burnt in closed chambers to produce lampblack.

4.—Utilisation of the Wood of Trees which have been tapped.

In the *Indian Forester*, February, 1888, attention is drawn to the mistaken belief that trees grown for timber cannot be tapped, and Colonel Bailey says:—"The effect of tapping the pine is to cause a flow of resin towards the lower portion of the stem, which thus becomes charged with that substance, and is rendered harder and more durable than the upper portion of the tree. The resinous wood is used for various purposes: very largely for railway sleepers, when it is injected with creosote or sulphate of copper. Planks and scantlings are sent for sale to Paris; while poles, extracted during thinnings, are used as telegraph posts and mine-props. Charcoal is also made in some forests."

II.—UNITED STATES.

The chief supply of turpentine in the United States is now almost wholly derived from the long-leaved or yellow pine (P. **australis**) of the Southern States.

The method of obtaining the turpentine is described by Mr. F. B. Hough* in the following words:—

"In winter the trees are 'boxed' by cutting a hole in the side, about 3 inches wide, 6 inches deep, and 12 inches long, near the foot of the tree, forming a cavity that will hold about 3 pints. The turpentine begins to flow early in the spring, and continues till towards the end of summer. The incisions are enlarged and extended higher up about once in a week or ten days, and sometimes two or three 'boxes' are cut in the same tree. The crude turpentine is dipped† out of the 'boxes,' and scraped off from the trees from time to time, and now the greater part is distilled near the forests, and the refined products sent from thence to the markets.

"In North Carolina the turpentine is collected about once a month, and 10,000 trees will, in a good season, yield 50 barrels of spirits of turpentine and 200 barrels of rosin. In other regions the trees are cut from twenty to thirty times in a season, and yield from eight to ten dippings. A man will 'chip' from 10,000 to 12,000 boxes in a week as a task. From 1,000 boxes they dip from three to five barrels of 280 pounds each.

"The yield per box in soft turpentine is from ten to twelve pounds, or twenty to twenty-five to the tree of usual size. A barrel of turpentine will yield five gallons of spirits of turpentine, and from sixty-two to sixty-five per cent. of its bulk in rosin. The product of the first year yields a fine light resin, and it grows darker from year to year. A still of forty barrels capacity will distil the crude product of about 350,000 boxes.

"Turpentine is produced to advantage only in warm climates, and in a given place to better advantage in hot and humid seasons than in those that are cold and dry.

"Trees exposed to the air and the sun yield better than those that are crowded and shaded, and those with a well-developed top and well set with branches much better than those with thin and light foliage."

III.—INDIA.

The question of creating a demand in England for Indian resins and turpentines, the manufacture of which is still in its infancy and requires development, has been before the Government of India since 1881.

In 1885 the following summary of the main facts elicited by enquiries in the North-West Provinces, Panjáb, British Burma, and Assam, as to the likelihood or possibility of establishing a trade in turpentine between India and England, was sent to the Secretary of State:—

1. **Cedrus Deodara** is far too valuable on account of its timber to permit of its being tapped for resin; besides, it only grows in the higher hills, and is thus too far removed from the market. Similarly the high cost of transport from distant forests places both **Abies Webbiana** and **A. Smithiana** out of consideration. The only conifers, therefore, that need be taken into account in connection with the extraction of turpentine for sale are the pines of Assam and Burma, **P. Khasya**, and **P. Merkusii**, and those of the North-Western Himálaya, **P. excelsa** and **P. longifolia**.

---

* Elements of Forestry, Cincinnati, 1882.

† Oil of turpentine is distilled from the liquid crude turpentine collected in *boxes* or artificial cavities cut in the trunk of the tree. This liquid substance is technically called *dip*.

2. The area of forests containing trees of **Pinus Khasya** is estimated to be—

		Sq. miles.
Assam		230
British Burma	Tenasserim Circle	40
	Pegu Circle	4
	TOTAL	274

Of the area in Assam, only 33 square miles are at the disposal of Government, the remainder being the property of private persons and subject to 'jhum' cultivation. The forests contain mostly young trees, from which only a very small yield, if any, can be expected at present. The area in British Burma could, with careful fire protection, be largely extended, and the hill-sides transformed into pine forests; but the existing forests are situated at an elevation of from 3,000 to 7,000 feet. They are, moreover, far removed from the market and are inaccessible, so that their management would be expensive. From experiments made it has been ascertained that the cost of crude turpentine obtained from P. **Khasya** amounts to R36 per 100lb delivered in Moulmein, and R32 for the same quantity brought from the Khasi hills in Assam to Calcutta. The supply at present is very limited, but it could, no doubt, be increased by careful conservative management of the forests.

3. The forests of P. **Merkusii** extend over an area of about 50 square miles in the Thoungyin valley of the Tenasserim Circle. They have been much cut up by taungya cultivation, but successful fire protection would suffice to re-stock the areas, and the forests could be extended without difficulty by propagating the tree. Experiments have shewn that the resin can be extracted without killing the tree, and that a tree of 6 feet girth can yield ·12lb at the first tapping. The quantity will decrease in the second and third years, after which the tree will require a lengthy period of rest. The cost of delivery of 100lb of crude turpentine at Moulmein amounts to R12. The quantity at present available is small, though it could be largely increased.

4. The areas covered with forests of P. **longifolia** lie in the North-West Provinces and the Panjáb, and are much more extensive than those of the other pines already mentioned, aggregating from 3,000 to 4,000 square miles, including those in Kashmír and other Native States. Most of the forests are very open and exposed to annual conflagrations, but they would rapidly improve with the adoption of a system of fire protection, which is absolutely necessary if they are to be worked for turpentine. Trees measuring between 4 and 6 feet in girth yield from 5 to 6lb at the first tapping, and, unless greatly overtapped, do not die from the process. The yield rapidly decreases however, and only about 10 or 12lb per tree can with safety be obtained every four or five years.

5. It will be observed that, in every case, strict fire protection on a large scale is indispensable to the success of the operations, and this can only be undertaken at present if the extraction of turpentine promises to be a success financially, a contingency which seems very doubtful, as it will hardly be possible to deliver the crude material at any railway station in India under an average cost of from R8 to R10 per 100lb. The question whether experiments should be continued in the hope of establishing a trade in turpentine between India and England depends entirely on the price which it is likely to fetch in the English market.

1.—Pinus longifolia (Chír) and excelsa (Kail).

In 1898 a letter was sent by the Government of India to the North-West Provinces on the subject of the necessity for securing a market in Europe for the large quantity of resins and turpentines that Indian pines can yield, but

which remains unutilised. It was considered expedient to lose no opportunity of devising cheap, rapid, and effective methods of tapping and distillation and of the preparation of the numerous secondary products of distillation, and also of studying the conditions under which the trees give their largest yield. The Conservator of Forests, School Circle, was requested to set on foot experiments in connection with **Pinus longifolia** and **excelsa**, and among other points to determine the following :—

(1) The cheapest, quickest, and most effective method of extracting the resin from each kind of tree.
(2) The season of the year at which the work should be done.
(3) The minimum age at which trees should begin to be tapped, when it is not intended to tap them to death (*gemmage à mort*).
(4) The number of years in which tapping to death kills a tree.
(5) The number of years during which a tree, which it is not intended to kill (*gemmage à vie*) can be continuously tapped; also the interval of years after which it may be tapped again, if the operation had to be discontinued in order to give it rest.
(6) The effect of tapping on the timber of the trees.
(7) The most favourable conditions as respects soil, aspect, elevation, gradient, climate, and closeness of leaf canopy under which trees to be tapped should be grown.
(8) Outturn of resin per tree of various sizes and per acre fully stocked.
(9) Distillation of pure oil of turpentine.
(10) Expulsion of all trace of oil from colophany of **Pinus longifolia**.
(11) Preparation of the various secondary products of distillation.

According to the *Indian Forester* (February, 1888) "the aggregate area under **Pinus longifolia** is comprised in the outer Himálayan belt, varying from 20 to 40 miles in width, from Nepál to the North-West frontier. No very approximate figure can be given for the total area lying inside British territory, but it certainly exceeds 2,000 square miles, distributed as follows :—

	Sq. miles.
Kumaon and Garhwal (Sarda to Jumna)	1,000
Jaunsár (Jumna to Tons)	300
Panjáb	not less than 1,000

of which only about 500 are at present workable."

In his working-plan of the Chír Forests Circle,* Jaunsár Division, North-West Provinces, Mr. N. Hearle says with reference to tapping for resin :—"As this is as yet only in an experimental stage and its commercial success is not yet assured, no regular system of working can be laid down here. It will not, however, be necessary, to confine our operations to the Chír areas within 2 miles of the river, but all the Chír forests can be worked for this purpose. Altogether there are probably about 90,000 trees over 2 feet in diameter, and about the same number of second class trees from 18 to 24 inches in diameter which could be tapped. The large mature branchy trees in the compartments which have been felled over could be tapped to death, especially as this will favour the production of seed. The others can be tapped so as not to kill them."

As regards the available quantity of **Pinus excelsa** it is stated in the *Indian Forester* (February, 1888), that about 200 square miles are supposed to exist between the Sarda and the Ganges, and very little between the Jumna and Ganges.

Two methods of tapping the trees for resin may be described, *viz.*, Native and European.

The rough system employed by the hill-men in Kumaon and Garhwal,

* Allahabad, 1889.

described in the *Indian Forester*, 1888, is to cut a sort of niche into the trunk about 3 feet from the ground. The bottom of the niche is hollowed out to receive the resin that trickles down its sides. The resin is collected as the niche fills, sometimes as often as every second or third day, but usually between the fourth and fifth days.

The niche has to be deepened and lengthened from time to time, so as to freshen the wound and keep up the outflow of resin; otherwise the old resin would harden on the sides, and form an impenetrable crust through which no resin could ooze out. The same niche is, as a rule, used for two years and sometimes even for three, when no fires occur in the meanwhile to burn and scorch the resin-incrusted sides. The hill-men seldom concern themselves about the life of the trees they tap, and generally work three niches simultaneously in one tree.

The crude resin obtained by natives of the Himálayas from **Pinus longifolia** is said* to be sold in the bazárs under the name of *birôza, gandha phiroza, dhúp, berja, lisa, khalja*, etc.; and a small quantity of turpentine is said to be distilled therefrom for sale in the neighbouring towns.

Systematic tapping operations have been carried on since 1887 in the Chír and Kail forests in Jaunsár by the Forest Department. The following interesting notes on the operations were made by Mr. C. G. Rogers, Instructor at the Forest School, Dehra Dun, during the Jaunsár tour, 1891 :—

"Mr. Moir, the Divisional Officer, told us the following history of the development of the resin works. In 1884, twenty Chír trees were tapped for resin. A nick was cut in the wood of the tree itself, as is done by the natives of Kumaon, and the resin allowed to accumulate in the nick. The dimensions

Fig. 3.

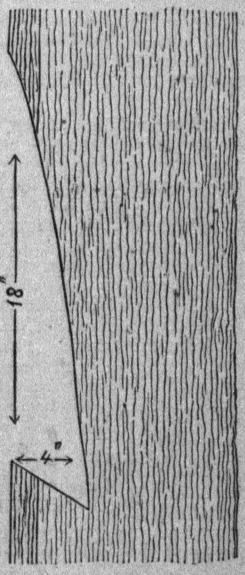

Fig. 4.

* *Indian Forester*, Vol. IX, 1883.

of the cut thus made are shown in Figs. 3 and 4. The trees were tapped from April to November, and the yield was as follows :—

10 trees (Dharmigâd, yielded 30 seers.
„ „ (Chattragâd) „ 36 „

"Resin-tapping works were instituted on a larger scale in 1888. They were of an experimental nature, and, consequently, the cost of the operations was high and the yield of crude resin small.

"1,024 Chír and 501 Kail trees were tapped in the Begúr, Málón, Ninús, and Kathyán blocks, the number of blazes being 2,873, or nearly two per tree. Incisions, 12" long and 6"-9" broad, were made, and the cuts renewed once a fortnight. By the end of November, 1888, they were 24"-30" long.

"Zinc, tin, and unglazed earthenware pots have been tried for catching the resin. The earthenware pots only cost 6 pice, and some of them have lasted three years. An objection to the unglazed pots is that they absorb a large quantity of water during the rains, and, consequently, deteriorate. The pots might, I think, be easily and cheaply glazed with *kanch*, as is done in the case of earthenware vessels made for the Military Department at the Meerut Jail.

"The blazes in the trees were made with the adze (Fig. 5) in common use

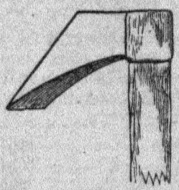

Fig. 5.

in the Jaunsár village. A set of tools sent out from France was tried, but their uses were not thoroughly understood, and, as they were found to be too heavy, they have not been brought into general working.

"The resin was first collected in a haphazard way, but it is now found that one man can look after 500 trees. His work consists of collecting the crude resin, refreshing the cuts when necessary, doing general repairs to the pots, etc. The resin is removed from the pots and packed in old kerosine oil tins. When the tins are full, their mouths are soldered, they are packed in wooden cases, and carried by mules or cattle to Chakráta and thence by cart to Dehra. A tin contains about 20 seers of resin on an average.

"The yield of resin in 1888 was 107 maunds, of which 98 maunds were sent to Dehra for manufacture. The yield between the 15th July and 30th August (when the rainfall is greatest) is very small, indeed in some cases practically nothing.* The cuts are not renewed during that time, and the resin is not collected. During the breaks in the rains, when the weather is warm and the sun strong, the resin flows most freely. The average yield per tree is 2 seers 14½ chattaks. Two cuts are usually made in each tree, but, in the case of large trees, as many as ten cuts have been made.

"The total cost of tapping, including cost of tools, pots and distilling apparatus was R1,764, of which R1,006 were expended on tools, pots, etc., and

* Experience both in Jáunsár and in the Panjáb has proved that, although the flow of resin is most active during the season of rest and when the weather is warm and dry, it still continues to ooze out in fair, and sometimes in considerable, abundance throughout the rest of the year. Pots left hanging in winter, under the snow, have been found to have overflowed with resin (*Indian Forester, 1891*).

R758 on collecting and producing 107 maunds of resin, which makes the cost of production a little under R8 per maund..

"In 1889, 1,973 Kail and 3,215 Chír trees were tapped, and yielded 2¾ and 6 seers per tree, respectively. The outturn was 604 maunds of crude resin. The tapping has not yet affected the trees, and, if profitable, the same trees will be tapped for four successive years. The distillation was done at Deoband, and 312 maunds of crude resin were distilled yielding —

Colophany	200 maunds.
Turpentine	42 ,,
Loss of weight (water and dirt)	70 ,,

This gives per maund—

Colophany	26 seers.
Turpentine	5 ,,
Waste	9 ,,

"197 maunds of colophany were sold at R4-8 per maund, and 18½ maunds of turpentine at R16 per maund, yielding a profit of Ro-14-9 per maund, excluding capital outlay, or annas 10 per maund net.

"In 1890 the work was continued. 473 Kail and 115 Chír had become exhausted and were abandoned.

"1,540 Kail and 3,100 Chír were again tapped, and the outturn was :—

Chír 286 maunds	or 3·69 seers per tree.
Kail 41 ,,	,, 1·08 ,, ,,

"The tapping still had no effect on the vegetation of the trees tapped.

"A still was set up at Dehra in October 1890.

"Four tanks, two at Kathyán and two at Danichkhera, were made to store the crude resin in. At the former place the walls and bottom are of wood, and at Danichkhera the tanks are of masonry (stone set in lime) and have wooden covers. Before these tanks were used, the resin, when the supply of tins ran short, was stored in vessels made by hollowing out a piece of a stem of a Chír tree. These were furnished with wooden covers, but were not durable and were found to leak.

"The cost of the resin delivered at Chakráta in 1890 was R3-2-1 per maund, which was made up as follows :—

	R	a.	p.	
Cost of collection	1	11	4	per maund.
,, ,, tanks, soldering boxes, etc.	0	12	9	,, ,,
,, ,, carriage to Chakráta	0	10	0	,, ,,

"The stock in the forest at the end of 1890-91 was 293 maunds, of which 220 maunds were afterwards sold at Kathyán at R4 per maund, and 20 maunds at R4-8 per maund.

"The cost of the collection of resin at Kathyán is—

	R	a.	p.	
Collection	1	11	4	per maund.
Packing charges	0	12	9	,, ,,
	2	8	1	

"Offers of R4 and R4-4 per maund have been received for the crude resin without tins or boxes delivered at Kathyán.

"The following is a brief description of the resin works as they are carried on at present :—

"An incision about 1 foot long, 4 inches wide and, at the base, 2 inches deep (leaving out the thickness of the bark, which often reaches a thickness

of 2-3 inches) is made in the tree by means of an adze (*bassula*). A gouge chisel (Fig. 6) is then driven into the tree just at the bottom of the incision

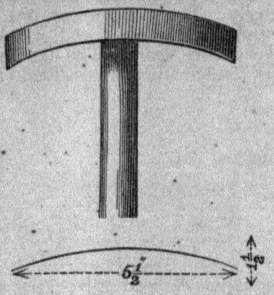

Fig. 6.

made by the adze, thus making a curved cut about 5½ inches long into the tree. Into this a strip of zinc, 5 inches long and 1½ inch wide, is driven by a wooden mallet, and forms a lip from which the resin flows into the pot placed below to receive it. The cuts are renewed,—*i.e.* lengthened and deepened—about twice a month in order to allow the crude resin to flow freely. The length of the cut at the end of the year's work is about 2 feet.

"The cuts on some of the trees which have been tapped for two or three years are only 2-3 feet long and 4 inches deep at the bottom. The incisions

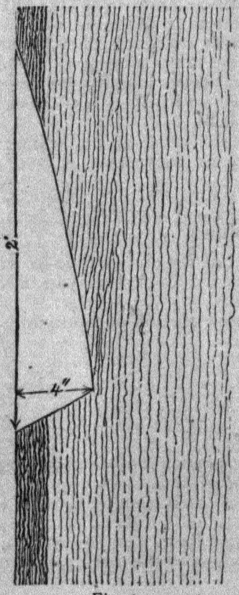

Fig. 7.

made in the trees which are being worked for the first time this year are about 4 inches wide and 1 foot long. The depth of the cuts at the end of the season is about 3-4 inches at the base, decreasing until the top of the incision is reached (Fig. 7).

"The thick bark of the Chír pine is not cut away on either side of the incision, but is left close up to the edges of the blaze (Fig. 9).

"The pot hangs on a nail, and is further secured to the tree by a piece of string passed round it and fastened to a nail driven into the bark on either

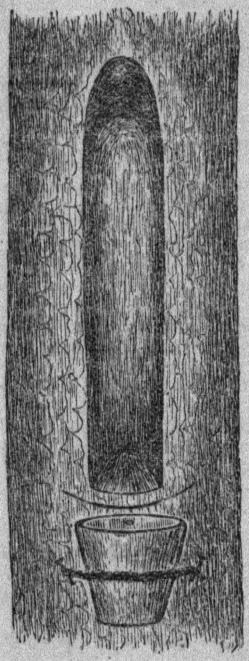

Fig. 8.

side of the pot (Fig. 8). The pot is covered with a piece of bark to prevent evaporation, and dirt from falling into it.

"We observed that only the outermost layers of the sap-wood, immediately beneath the bark, yielded any appreciable quantity of resin. This layer is at the most $\frac{1}{2}$-$\frac{3}{4}$ inch in thickness. This thickness, I think, is more than was observed in the majority of cases, it often being as small as $\frac{1}{4}$ inch. This portion was cut through during the first 3 or 4 inches of the slanting cut, and the resinless layer reached. The resin formed on this portion, and then trickled down over the rest of the blaze into the pot below, being augmented by the resin which came from the same layer of tissues on the sides of the

cut. The exposed portion of the wood deeper than this produced no appreciable quantity of resin. I expect that an appreciable quantity of turpentine evaporates on the way down, and certainly some water must be given off, thus making the resin less fluid and, consequently, checking the flow of resin. In my opinion, as the cuts are at present made, it is only the top 3 or 4 inches and about ½ inch at each side of the cut which yield any appreciable quantity of resin, and the rest of the cut, passing, as it does, through layers of wood in which the quantity of resin is very small, if not practically absent, is useless and harmful. In a freshly cut tree it was observed that the crude resin was flowing from the wood formed during the last four years. Inside the outer corky bark, between it and the wood proper, is a layer of white cortical tissue, the cells of which have not lost their water and food material. This layer soon becomes brown on exposure to the air owing to the formation of cork, and must not be confounded with the wood proper. It is the layer of wood for about ½ inch inside this that gives the principal yield of resin. The effect of not removing the bark on either side of the incision, besides making it much more difficult to take a thin layer of wood off the cut (in freshening it), is that a good many bits of bark fall into the crude resin, collect in the pot, and materially add to the impurities. The crude resin which hardens on the cut is scraped off with an iron spoon, and mixed with the more liquid resin collected in the pot. The rough, scaly portions of the bark should, in my opinion, be removed before the incision is made, leaving the innermost thin brown layer, for a width of at least 4 inches greater than the maximum size the incision is likely to attain over the portions which it is intended to tap during the year. This should be done in February, a short time before the tapping season begins.

"This should cause a decrease in the amount of impurities in the crude resin, more especially the very minute particles of bark, etc., which it is found very hard to separate from the crude resin before it is introduced into the still, and which, becoming burnt in the process of distillation, probably materially darken the colour of the resulting colophany, *i.e.*, account for the darker colour of the Indian colophany as compared with the finer qualities produced in France. By removing the thick bark it will be easier to take off thin layers of wood when refreshening and lengthening the cuts, and the total depth of the cut at the end of the season would be very materially reduced—a most important consideration as far as the healing over of the wounds made in order to obtain resin is concerned. Figure 10 shows how I

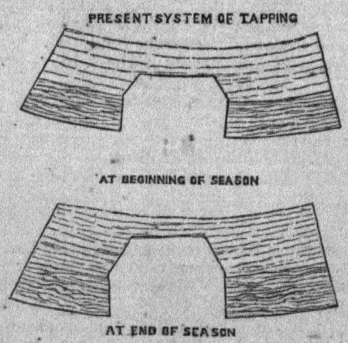

Fig. 9.

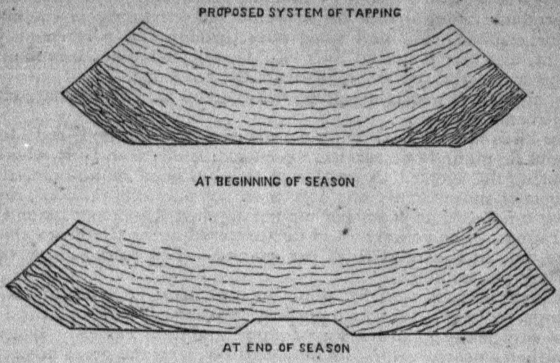

Fig. 10.

propose that the cuts should be made. The total depth of the cuts at the end of the season should not, in my opinion, exceed $\frac{1}{4}$ of an inch.* The height might be materially increased. The same incisions might be continued upwards each year, so as to bring a new set of resin ducts into bearing. The pot should be removed to the top of the last year's cut,* and a fresh cut made as before. This point does not seem to have been sufficiently considered so far. The tendency has been to deepen rather than to lengthen the cuts. The trees tapped are large ones, and there is no reason why the cuts should not be at the same time wider, so as to increase the area of the resin-producing areas."

The process of extraction of tar from Chír pine wood at Chattragâdh is thus described by Mr. Rogers :—†

"The tar is separated by subjecting small pieces of Chír pine wood to slow complete combustion in a kiln, through which only a small supply of air is allowed to pass.

"The kiln is made of stones and mud-mortar, the interior being faced with lime, and is egg-shaped inside; its height and also its maximum diameter being 5 feet. It tapers towards the lower end, into which is fixed a perforated iron plate. At the upper end of the kiln is an opening 2 feet in diameter.

"The wood, cut into long strips 1 or 2 feet long and 4 or 6 inches round, is introduced at the upper end of the kiln. The pieces of wood are packed as tight as possible (the closer they are together the better). The upper opening is then closed with a dome of mud-mortar and stones, three holes being left to admit air. The wood is lit from the top, and burns downwards, the rate of burning being regulated by closing or opening the different holes.

---

* As pointed out by Colonel Bailey (*loc. cit*), this has the great advantage that the resin is not mixed with any large amount of foreign substances, and that, as it runs down the length of a single year's cut only, the loss by evaporation is less than when it was collected at the foot of the tree. When the pot is too high to be reached from the ground, it may be reached with a ladder or removed by a sliding staff, furnished with a pair of metal arms to grasp the pot. And, if a broad-bladed hook-like tool is fixed to the staff, the cuts can be renewed by the workman while standing on the ground.

† Journal of the Hill Tour of the Imperial Forest School, April and May 1891.

"The charge of the kiln is about 15 maunds, and it takes nine days to burn, the volatile products being driven off and charcoal remaining in the kiln.

"Crude tar, organic acids, and water pass through the perforated plate at the bottom, and are collected in tins. Good pitch has been made by driving off the water and organic acids from the crude tar.

"From 15 maunds of wood thus subjected we get 6 maunds of charcoal and $1\frac{1}{2}$ maund of crude tar.

"Two new kilns have been recently constructed at Khunigod and Darmigod, and about 80 maunds of tar have been extracted from Chîr wood (**P. longifolia**) during the winter. A portion of this has been manufactured into pitch. The cost of manufacture has now been considerably reduced, and at Darmigod has amounted to R2-8 per maund against R3-12 per maund last year at Chatragod. The actual cost of tar delivered at the Chakráta chowky will, therefore, not now exceed R3-8 per maund. The price of coal tar at Chakráta is R10 per maund.

"The tar is at present used for departmental uses, such as for tarring bridges, railings, roofs, etc., for which purposes it is mixed with one third coal tar, as it is not sufficiently adhesive if used alone, and soon washes. If used in this way, it adheres nearly as long as pure coal tar, with the great advantage that the cost is reduced by about one-half."

The following note on the resin-tapping industry is taken from the Administration Report of the Forest Department, North-West Provinces, 1890-91:—

"This industry promises to become one of great importance in the hills, as numerous enquiries both for crude resin and for the manufactured colophany or resin are being sent. We are offered as much as R4 to R4-4 per maund of crude stuff in Chakráta, and steps have consequently been taken to tap a much greater number of trees in 1891, and improve the style of cut so as to ensure a better flow and less waste. It has already been recorded that 219 maunds of crude resin were worked up at the Forest School in Dehra and converted into 170 maunds of resin and 390 gallons of oil of turpentine. The resin was all sold to the North-West Soap Company at Meerut at R5-8 per maund; but so far the turpentine has not sold well, although those who have tried it, and among them the Deputy Superintendent of the Great Trigonometrical Survey at Dehra, have pronounced favourably on its quality. The Conservator has not the slightest doubt of it eventually finding a very good market. All it wants is to be known, and he will be glad of any assistance the Government can give in bringing it to the notice of Railway and Public Works Department Engineers and other likely customers. What has been sold has been sold at a nominal rate of R2-8 per gallon. The value of the resin and turpentine produced amounted to R1,740, and against this must be set the cost of carriage from Chakráta to Dehra and other expenses, so that the following may be said to be the net revenue under departmental working:—

Departmental Working.

	R	R
Value of rosin and turpentine turned out		1,740
Carriage from Chakrata	114	
Charges in Dehra for distilling, tins, jars, etc. . . .	438	
Ten per cent. of cost of still and other plant, R350 . .	35	
One-fifth of pay of Forest Ranger in charge for five months .	50	
		637
Net Revenue		1,103

or, per maund of crude rosin worked up, say R5, which is 12 annas to R1 more than we were offered in Chakráta.

"The cost of collection in the forest of the crude resin and its delivery in Chakráta is R3-2 per maund, so that the profit from the work is on an average R1 per maund under local sales and R1-14 per maund under departmental distillation.

"Another industry which is just starting, and has, the Conservator thinks, a good future is that of the extraction of tar from roots and refuse of the Chir pine and its boiling down into pitch. Last year 90 maunds of this tar, which resembles what is known as 'Burgundy pitch,' were produced and chiefly used locally for tarring the roofs of houses and the timbers of bridges and fences."

A small quantity of crude resin of **Pinus longifolia** was sent, in 1888, to the Anglo-Indian Varnish Company, who reported on it as follows :—

"The crude turpentine had the appearance and consistency of lard. It was put, without any admixture of water, into a copper still with a worm (an ordinary *pot still*), and gently fired. The material that came out was turbid, and had something the appearance of milk. The residue in the still was a white fatty substance with dirt. The proceeds of the first distillation were mixed with water, and subjected to another distillation, or rather rectification.

"From this process we obtained—

(I). Oil of turpentine containing in solution a large quantity of resin.
(II). Oil of turpentine, more or less pure, which was limpid when received from the still, but has since become slightly coloured.
(III). Oil of turpentine containing a very large quantity of naphtha.
(IV). Rosin containing a large quantity of oil of turpentine and naphtha.

"The rosin thus obtained, on being subjected to dry distillation, gave off a considerable quantity of naphtha and the residue (No. V) is a more pure rosin than No. IV, but still contains much oil, which should not be present.

"We made some copal varnish with No. II when limpid, but found the varnish would not dry, and had a peculiar smell.

"This, we must say, has not been a fair trial. We should have got the oil of turpentine much purer, and it is probably owing to this that the varnish does not dry.

"It is the first time we have attempted to distil the raw material, and have no doubt that further trials would lead to much better results."

A sample of oil distilled by Mr. Fernandez at Naini Tal was examined by Messrs. Morrison & Co., who reported that it was good, but a little wanting in strength. The results of its application in cases of rheumatism were stated to be as good as those obtained with French oil.

Specimens of soap prepared, respectively, with 10 per cent. of turpentine and with rosin manufactured at Dehra Dun have been sent by the North-West Soap Company, Meerut, to the Imperial Institute. The soap prepared with the rosin made at Dehra is darker in colour, but otherwise of nearly as good quality as that prepared with American resin. Recent consignments of rosin sent from Dehra Dun to the North-West Company are reported as being of superior quality to the resin previously sent.

The turpentine manufactured at Dehra Dun has been tried by the Bombay-Baroda and Central India Railway, and found to be of good quality and suitable for railway carriage painting. A more extensive trial is to be made with it.

The following notes on the extraction of crude turpentine from Pinus **longifolia** were prepared by Mr. Lemarchand, Deputy Conservator of Forests, Kangra Division:—

"Experiments were made with reference to the extraction of crude turpentine in 1885 and 1886 with the following results:—

"In March, 1886, 160 Chil trees, with an average girth of from 4 to 6 feet and age from 60 to 90 years, were selected and marked for experimenting on In April, triangular-shaped niches, 18" long and 6" deep, were cut into each tree. Men were employed to empty the niches as fast as they filled. The exudation of resin was active in April and May, slower in June, and ceased entirely in July.

"The total outturn of crude turpentine from the 160 trees was 7½ maunds, or an average of 30 chittaks per tree.

"The total cost, including wages of carpenters employed in cutting out niches, coolies collecting the resin, earthen vessels for storing the produce, etc., was R19-8-0, or R2-7-6 per maund.

"The method adopted in 1885 was by making a straight flat cut or scar through the bark. Earthen vessels were fixed to catch the turpentine. This method yielded only 13 chittaks per tree – less than half the quantity produced in 1886—and the cost of production (owing to the number of earthen vessels required) was R5-8 per maund, as against R2-7-6 per maund in 1886.

"The trees tapped in 1885 were again tapped in 1886, but yielded only an aggregate outturn of 16 seers of crude turpentine.

"Experiments were also made on trees that had been burnt in previous years during forest fires. These yielded little or no resin.

"It would probably pay to set up a still for the distillation of the crude article on the spot of production, as there is a sufficient quantity available to compete with the American article. The cost of transport to Karachi, and from there to Madras by sea, prevented the possibility of selling the crude material to Messrs. Morrison & Sons, Anglo-Indian Varnish Manufacturing Company, Madras, whose report on specimens sent to them has already been quoted (p. 18).

"The crude material extracted in 1885 and 1886 was sold at an average rate of R4 per maund."

2.—Pinus Khasya.

The following report was made, in 1885, as to the extent to which **P. Khasya** is available in British Burma:—

Pegu Circle.—The area of the forests of **Pinus Khasya** is found on examination to be only about 3 or 4 square miles; but a large proportion of the forest is covered with young growth, which has sprung up on the sites of old taungya grounds. The tree grows plentifully along the Panlaung ridge itself which forms the boundary of the Pegu and Tenasserim circles, but it only spreads over insignificant tracts to the west or within the Pegu Circle. Pine forests are also to be seen beyond Nat-tung, but they have not been examined. The tree is never tapped for turpentine; the wood is used for torches by the villagers in the neighbourhood.

Tenasserim Circle.—The area of the forests of **Pinus Khasya**, which are only found on the higher hills in the Upper Salween District from an elevation of 3,000 to 7,000 feet, is estimated at from 35 to 40 square miles. This area could only be extended by demarcating certain tracts and State Reserves, but this would seriously affect the Karen population, who subsist wholly by taungya cultivation, and for whose maintenance the existing taungya grounds barely suffice. Judging from the position of these pine forests and their great distance from Papun, the highest point up to which the Yoonzaleen river is navigable for small boats, it is considered doubtful whether their resources in turpentine could ever be made available.

In the *Indian Forester* (February, 1888) it is stated that—

"The resin of the Khasya pine is believed to be the most valuable in India, and has attracted the special attention of Sir Joseph Hooker. Forests of this tree are estimated to cover about 270 square miles, of which 230 are in Assam, the remainder being in Burma. Of the area comprised in Assam, only 33 square miles are at the disposal of Government, the rest being in private hands and regularly subject to jhooming, and, therefore, mostly too young at present to be in a condition to yield. The small area in Burma can, however, it is confidently believed, be largely extended and improved, nothing but fire conservancy being required to transform the hillsides into pure pine forests. But the pine localities in both provinces are far removed from markets, and are so little accessible that the cost of 100lb of crude turpentine delivered at Calcutta and Moulmein would, under present conditions, be ₹32 and ₹36, respectively.

"In Burma the Khasya pine is never tapped for resin. The wood is used for torches by the villagers in the neighbourhood of the pine forests."

The following note on the extraction of crude turpentine from the wood of **Pinus Khasya** in the Khasia hills, Assam, is taken from a memorandum by Mr. G. Mann :—*

"In the bazars of the Khasia hills a very resinous wood is sold, which is used by the Natives, as well as by Europeans, for kindling fires, and it is very handy for this purpose.

"This wood is produced artificially in **Pinus Khasya** by cutting a hole in the lower part of the trunk of the tree about one foot above the ground. This hole is usually 9 to 12 inches wide, 6 to 9 inches high and 2 to 3 inches deep. After this hole has been cut, the bark and a little of the wood is removed from a strip about 12 inches wide and 4 feet up the trunk just above the hole, which causes the resinous sap to exude, and all the sap-wood along the strip where the bark has been taken off to become thoroughly saturated with resin within the next 12 months; and it is even said that the wood of the smaller branches in the crown becomes much more resinous in trees thus cut."

For the extraction of liquid turpentine from the wood saturated with resin, the wood is cut into small pieces or chips, and placed in an earthenware cooking pot or vessel till it is full. The mouth of the vessel is closed by tying large, smooth leaves (usually of **Phrynium**) over it; the vessel is turned upside down and placed on a hearth, cut out of the hillside. A gentle fire is then made on or above the vessels holding the wood, and the hot ashes and burning charcoal kept spread over and around the pots to heat them, the consequence of which is that all the turpentine oil exudes from the wood, and drops through the holes made in the leaves into the smaller vessels placed underneath to receive it.

The resinous wood used for the preparation of turpentine sold, in 1882, at the rate of about 80lb for the rupee; and it was stated that sometimes it fetched half as much again, if there was not a very large amount brought to the bazar for sale.

In 1881 Professor H. E. Armstrong, F.R.S., wrote as follows regarding the crude turpentine :—

"It consists of a solid resin similar to colophany, and of a liquid turpentine oil. The latter is remarkably pure and free from smell, and ought, I should say, to be very valuable for purposes for which the French and American oils are used. . . . . Neither French nor American oil, especially the latter, are homogeneous, but this **Pinus Khasya** oil, so far

* *Indian Forester*, Vol. VII, 1881-82.

as I can judge from the examination of the small quantity at my command, is almost a pure substance"

A sample of turpentine oil, the produce of P **Khasya** from British Burma, was sent to Professor Armstrong who reported* that "this oil is in every respect, so far as I have been able to ascertain, the counterpart of French turpentine, but its optical image, and, if it could be obtained in quantity, would form a most valuable article of commerce"

In 1892, the Conservator of Forests, Eastern Circle, Upper Burma, submitted the following note regarding the distribution and utilisation of **P. Khasya** in Upper Burma and the Shan States —

"The higher hills on which pines occur have been but little explored and the information recorded below is consequently incomplete There are probably large areas of pine forest of which we have at present no knowledge

"In the Southern Shan States Mr Jackson reports that pine forests occur both in the drainage area of the Irrawaddy and Salween They are generally situated at altitudes of 4,000 feet and over, though they occasionally descend as low down as 3,000 feet They are sometimes found forming pure forests, but are more generally mixed with *ingyin* (**Shorea siamensis**), *thitsi* (**Melanorrhæa usitata**), *tankhyan* (**Terminalia tomentosa**), *panma* (**Schuma, sp**), oaks and chestnuts The reproduction is invariably good The trees seldom exceed 6 feet in girth, but east of the Salween, where the largest and best forests are found, trees 9 to 10 feet in girth are not uncommon The total extent of pine forests in the Southern Shan States is considerable, as there is no State of any size which does not possess some pine-clad hills; but no estimate of area can be given The most accessible forests are in the Thamakan State on the cart road from the Meiktila road railway station to Fort Stedman Pine wood is seldom used for building purposes, as it will not stand the action of rain, but it is sometimes used for interior work in default of other timber Where pine forests are found in the neighbourhood of villages, the wood is collected and sold in the bazars for torches An oblique incision, 1 foot long, is made near the foot of the tree, and the resin which at once exudes is fired This causes the wood near the wound to become so resinous as to be quite translucent when it is chipped off and used for torches Under such treatment the trees are sooner or later destroyed by jungle fires, or else become so far cut through as to be unable to support their own weight Resin or turpentine is never collected in the Shan States or elsewhere in Upper Burma

In the Mandalay Division there is a tract of pine forest occupying the higher hill tops and slopes over an area of about 150 square miles on the Zawgyi river in the Shan States of Yatsank and Baw between Myogyi and Thondan The pines, which range up to 10 feet in girth, occur either pure or mixed with the trees above noted The lower slopes are occupied by *In* forests, but groups of pines have been found so low down as 2,500 feet The pine forest is generally very thinly stocked, and the ground in the more open parts is covered with tufts of short grass Reproduction takes place abundantly, but the young seedlings are constantly destroyed by the annual fires The trees are utilised to a very small extent for torches. Pine forests are also said to occur in Mainglôn, a district of Thibaw, but their extent is at present unknown

In the Ruby Mines District there are some important groves of pines near Bernardmyo and to the north of Mayôk. In the Bhamo district pines are found on the crests of the hills between the Namyin and Indawgyi rivers

In the Minbu, Yaw, and Chindwin divisions groups and belts of pines are not infrequent on the tops of the secondary ranges between the Chin hills and the Irrawaddy and Chindwin rivers, and in the Chin hills there are

* Trans Chem Soc, 1891.

reported to be extensive areas of pine forest, but only the western spurs have as yet been visited by Forest Officers. In the higher hills the wood is said to be generally used for building purposes. Linear valuation surveys made last year in some outlying pine tracts in the Minbu Division gave the following results :—

Area counted out acres.	Trees 6′ girth and over.	Trees 4½′ to 6′ girth.	Trees 4½′ to 1½′ girth.	Trees below 1½′ girth.
439	337	674	936	1,971

Owing to the generally inaccessible situation of **Pinus Khasya** forests and the high cost of labour, the prospects of establishing a trade in the timber appear very remote, but there is no reason why the forests should not be worked for resin and turpentine, especially in the Shan States, where, in many places, they are mixed with wood-oil (*thitsi*) trees, which are regularly tapped for varnish.

The Conservator proposed carrying out some experiments at Bernardmyo and in the Thamakan State, to ascertain the quantity of resin and turpentine procurable from each tree and the market value of the products.

The following note on the cost of extraction and yield of oil and resin from **Pinus Khasya** in Assam was supplied by the Conservator of Forests, Assam, in February, 1892 :—

"It was estimated by Mr. Mann, in 1884, that to extract the oil in the manner described above cost ₹18-8 per maund of 80lb or 8 gallons. It would now, owing to higher labour wages, roughly cost nearly 25 per cent. more, or ₹23 per maund, and, delivered at Gauhati on the Brahmaputra, it would cost ₹24-8 per maund.

"Mr. Mann's enquiries led him to calculate that 68lb—or, say, 7 gallons—of turpentine could be obtained from a full-grown tree of 4 feet girth, or one-sixth of the raw material used in the process; that trees should have attained the age of 50 years before being tapped, as the tapping process kills the tree; and that not more than 1,000 gallons yearly could be obtained from the entire area under pine forests in the Khasi and Jaintia hills, provided that these latter were protected. In writing the above it was estimated that about 230 square miles were under pine forest, of which only 33 square miles belonged to Government. The above area has probably been still further curtailed by this date, and, so far as my experience is concerned, the existing forests are not 50 years old. The Government forests about Shillong are still in the pole stage, and are probably under 30 years old. Such forests, therefore, according to Mr. Mann, would be immature for tapping purposes. It seems likely, however, that Mr. Mann indicated the above age as the lowest exploitable one because of the fact that the tree is killed by the process of extraction. In France, I believe, much younger trees are made to yield turpentine, and by methods that do not necessarily kill the tree. It would be interesting to experiment on some of our trees with this object."

3.—Pinus Merkusii.

It is stated in the *Indian Forester*, February, 1888, that "this pine is only found in Burma, where it covers about 50 square miles in the Thaungyin valley in the Tenasserim Circle. These forests are much more accessible than the Khasya pine tracts, and no difficulty is anticipated in extending them by the reservation of suitable tracts, as the population there is sparse

and the tree can be easily propagated. The cost of the P. Merkusii resin delivered at Moulmein is the same as that of the Khasya resin, but will be much reduced as soon as the valley is opened up by cart traffic. The few experiments hitherto made seem to show that a tree of 6 feet girth can yield 12lb during the first year in which it is tapped."

In 1885 the following report regarding the turpentine obtainable from Pinus Merkusii in British Burma was submitted by the Conservator of Forests, Tenasserim Circle:—

"The area of the forests of this tree in the Thaungyin valley (its habitat) is estimated at about 50 square miles. This area could be extended by propagating the tree over considerable areas in the unreserved forests, and in selected areas within the reserves, where the soil is suitable and where the *In* tree (Dipterocarpus tuberculatus) occupies the ground. In fact, there would be no difficulty in doubling the existing area if such means were adopted; and no hardship would be caused to the inhabitants of the surrounding villages if this were done, as the population is sparse in the Thaungyin valley, and the *In* forests, by reason of the poverty of the soil, are not resorted to for purposes of cultivation.

"As regards the cost of collecting the turpentine and delivering it at Moulmein, it has been ascertained that 6 gallons (52lb) of crude turpentine can be obtained from 25 trees in the course of 15 days, at a cost of R6 for hired labour. The cost of transporting these 6 gallons of turpentine from Myawaddi (the source of supply) to Moulmein is estimated at R4-12-0; and the total cost of crude turpentine delivered at Moulmein may, therefore, be estimated at R10-12-0, or R1-13-0 per gallon. Refined turpentine is sold in the Moulmein bazar for about R1-13-0 per gallon, the same rate as crude turpentine could be delivered at Moulmein.

"It is said that, if the turpentine were collected by the Karens and Shans of the Thaungyin valley during their leisure hours (in the same way that forest produce of all kinds is usually collected by them), the actual cost of its collection will be much less (probably by one-half) than the cost of collection by hired labour. It is also expected that, when cart traffic is established between Myawaddi and Kawkareit (*en route* to Moulmein), crude turpentine might eventually be delivered at from 14 annas to R1 per gallon.

"Experiments show that Pinus Merkusii can be tapped for turpentine without killing the tree, and that a tree 6 feet in girth will yield 12lb of turpentine in an ordinary dry season of three months. No information is available as to the average quantity of turpentine which could be obtained from a full-grown tree. It is not until a girth of 3 feet has been attained that the tree secretes any appreciable quantity of turpentine. The yield of trees 1 foot and 2 feet in girth has been ascertained to be respectively 8½ oz. and 1lb 7½ oz. in an ordinary season lasting three months.

"As to the total quantity of crude turpentine likely to be available, if circumstances were such as to admit of its remunerative extraction, no definite information is yet available. To ascertain this, it would be necessary to take up a sample area of about 50 acres, and subject only full-sized and larger trees to the tapping process, in accordance with the system in vogue in the forests of Europe. Moreover, the information thus obtained would have to be supplemented by surveys in order to ascertain the average number of trees suitable for tapping purposes per acre, and the precise areas on which tapping operations could be profitably conducted."

In May, 1881, a sample cask of (what was said to have been) turpentine of Pinus Khasya was sent to the India Office. In a letter from the Chief Commissioner of Burma, in 1885, however, a belief is expressed that the turpentine then sent was that of Pinus Merkusii from the Thaungyin valley.

NOTE ON TURPENTINE.

American turpentine is imported into India from England, French or other turpentine is not known in the Calcutta market.

The turpentine generally sold in the Calcutta market is impure It is largely adulterated in England with kerosene oil, naphtha, benzoin, etc, and a further adulteration takes place in India There is very little demand for pure unadulterated turpentine Purchasers do not look so much for quality as for quantity Merchants, therefore, keep only small quantities of pure turpentine, which they import direct from America, not through England

The points of good turpentine are that it is as clear and transparent as glass; that the odour is neither very strong nor bad; that it dries quickly, that, if sprinkled on white paper, it dries at once, leaving no marks behind, and that, when handled, it forms a coating of very fine white dust on the hand All these properties depend largely on the method of distillation. Any defect in the distillation lowers the quality of the oil. If any attempt is made to introduce the Indian product into the market, the greatest care should be taken in its distillation. Its resemblance to the oil already existing in the market is of far greater importance than its purity In point of fact, its purity must be destroyed before it is put into the market, and its resemblance to the American oil is the main object which should be kept in view The Calcutta merchant, from whom the present information was obtained, stated that, on one occasion, a sailor brought to Calcutta a large quantity of pure turpentine which he offered for sale, but that he had great difficulty in disposing of it, because its odour was somewhat different from that of the oil usually sold in the market It was at length purchased by Messrs Dykes & Co, the coach-builders

For internal administration medicinally, pure turpentine is required, but consumers generally buy it from shops for external application, and demand a large quantity for their half-anna or anna In such cases, they are supplied with stuff very largely adulterated with kerosene oil

It is estimated that the annual consumption of turpentine in Calcutta is from 10 to 20,000 gallons

Turpentine is shipped from America to England in tin canisters packed in wooden cases, but it is sent from England to India in iron drums tinned inside, as contact with the iron would discolour the oil

At the present time the wholesale price of turpentine ranges from R1-12 to R2-9 per gallon in Calcutta

In the London market the following are recent values of the various turpentines imported, as well as of rosin :—

American turpentine	25/3 per cwt.
„ *rosin* (common)	4/6 „
French turpentine	none *
„ *rosin*	none *
Russian turpentine	19/ and 19/6 per cwt.

American turpentine—

Average values, 1891

January	29/ and 29/9	July	27/3 and 28/9
February	28/6 and 29/3	August	27/3 and 28/
March	28/9 and 29/3	September	27/9 and 28/6
April	29/ and 30/3	October	27/ and 28/
May	29/3 and 30/3	November	26/ and 26/9
June	28/9 and 29/3	December	25/3 and 26/

* French rosin or turpentine seldom or never comes upon this market now, so that there is no means of recording prices or averages

American Rosin—

Average values, 1891.

Common strained

January	4/9	July	4/4½
February	5/	August	4 4½
March	4/9	September	4/3
April	4/9	October	4/6
May	4/7½	November	5/
June	4/6	December	5/

The Dehra turpentine is of very superior quality, but cannot at present be sold at the highest price obtained for the best imported turpentine It can be sold in Calcutta at R1-8 to R1-14 per gallon, and, if it became established in the market, could probably be sold at R2 to R2-4 per gallon

The Dehra turpentine cannot, however, aspire to conquer the Calcutta market, which is too far away and requires too much, all it can hope to do is to obtain a good sale in Upper India Messrs. Lyell & Co of Allahabad are advertising turpentine at R4-8 per gallon. If the Forest Department could get R3 per gallon, all round, for Dehra turpentine, it would be worth while to build a factory and manufacture it and rosin (which fetches now R5-8 per maund) wholesale

EDGAR THURSTON,

Offg Reporter on Economic Products to the Government of India.

G. I. C. P O.—No 921 R & A.—13-2-93.—100.

management in all forests which are considered to be necessary for the welfare of the country, who recognize the facts that must be faced to attain this object, and are prepared to face them. But it is quite natural that a far greater number should, in spite of the facts, take a very different view of the necessities of forest management, and this course is all the easier to the many, who, as pointed out by Mr. Baden-Powell, are incapable of perceiving the disastrous effects that the adoption of views similar to theirs has brought about in the past, nor the evils that the adoption of their policy is destined to bring about in the future. It is, therefore, a misleading and empty phrase to talk of enlisting the sympathies of Revenue Officers. That object could only be attained by smothering their much stronger feelings in the direction of *laisser aller*. Still less is it possible to "enlist the sympathies of the villagers," a much abused phrase of which we hear so much whenever it is desired to abandon scientific management or to grant them unnecessary concessions. Theirs is, even more than that of the Revenue Department, a hand-to-mouth policy, and they naturally treat as an excellent joke, any suggestion that they should exercise the slightest self denial or even care in order to preserve some of the forest for the use of those who are to come after them, although they may, and often do, recognize well enough the destruction that is going on, and the consequent evils in store for their descendants.

We often hear it said that the Forest Department should have full control of technical matters while the Revenue Department controlled the non-technical. Theoretically, this may appear to be an excellent arrangement, but those who think so, should tell us how it is to be put into practice. Theorists omit this important part of the programme. A few years ago, not *quite* recently—he has scouted many of his professions since then—Mr. Gladstone said, with reference to Home Rule, that to separate Imperial from Local business 'passed the wit of man.' We may borrow the phrase in the present case, and say that to separate the technical from the non-technical passes the wit of man. Surely this must be obvious in a thousand ways to everybody. Take, for instance, the familiar case of a closure against grazing. The actual prohibition certainly cannot be called a technical affair, but it may be the first and only step in the preparation of the soil for the reception of the seed and the only practicable means to that end and as such would be a technical operation (although the Revenue Officer might not see it) on which the very existence of the forest would depend. Who then is to say what is technical and what is not technical? And yet in all questions regarding the apportionment of control between the two departments, how much stress is apt to be laid on this point, and what tremendous castles in the air are erected on the assumption that the two functions can be sharply defined?

This fact—the impossibility of separating professional from non-professional functions—should therefore, be recognized. Until this is done, and until the principle is generally admitted that